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Impact of Exchange Rate on Gold Price in India

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Abstract
In this article we investigate the impact of rupee-dollar exchange rates on growth rate of gold price in India over the period 1970-2016. The investigation is done using some steps. In the first step we use Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) test to detect that the series is stationary or not. To show the long run association of the variables we apply Johansen Co-integration test. As there is no cointegration we apply unrestricted VAR method. Since the study variables are not cointegrated, there is no long run causality, there is only short run causality running from independent variables to dependent variables. Further the Granger Causality test determines whether growth rate of gold price depends on the growth rate of rupee dollar exchange rate or not. At last we also test the stability of the model using Eigen value statistic method. The main finding of this paper is that growth rate of gold price depends negatively and significantly on growth of rupee-dollar exchange rate, means that as rupee dollar exchange rate rises gold price decreases and vice versa. The study also shows that growth rate of gold price does not Granger cause to rupee-dollar exchange rate where as rupee- dollar exchange rate Granger cause to gold price in Indian economy. That is we can stabilise the Gold Price movement by controlling the exchange rate fluctuations.

Keywords: gold price, rupee-dollar exchange rates, Co-integration, Vector Auto Regression, Granger causality

1. Introduction
From the traditional days gold has its importance. It has been a symbol of status in the society and considered to be an instrument of investment by the people. Though gold is not considered as a primary form of currency in all countries, it has a significant influence on the value of those currencies too. There exist a correlation between the value of gold and the currencies of any country. Gold market and Foreign exchange market both provides better opportunities for investment so they attract the investors. Today, India is the largest gold importer. By the end of the Dec 2017, Indian gold import will increase to 700 tonnes and earlier it was 500 tonnes in 2016-17. There is an inverse relationship between the value of rupee-dollar exchange rate and that of gold price. Dollar is an internationally accepted currency and most of the international transactions take place in terms of dollar. The major reason behind the inverse relationship between gold price and rupee-dollar exchange rates is that as the dollar's exchange value decreases, it takes more dollars to buy gold, which increases the value of gold. As a result gold price increases. The fluctuation of the value of dollar depends on several factors like shifts in monetary policy, international trade, etc., but the gold price is largely determined by its supply and demand. Now-a-days the investment behaviour of Indian population is observed to be changing. They think that investment in gold is a safe option. The volatility of market panics the investors and makes the investment decisions difficult and risky. In this context, the present paper is an attempt to examine the causal relationship between gold price movement and rupee-dollar exchange rate movement in the Indian context.

Objective of the Study
The main objectives of this study are:
- To analyse the relationship between growth rate of gold price and rupee dollar exchange rate.

- To analyse whether the relationships are long run or short run phenomena, or both.
- To analyse whether there is any causal relationships between growth rate of gold price and rupee dollar exchange rate.
- To analyse the directions of the causality between growth rate of gold price and rupee dollar exchange rate.

Sources of Data
In this study we use secondary data cover annual time series of 1970 to 2016 (or 45 observations) in Indian economy. The data set consists of observations for gold price (Rupees per 10 grams in Mumbai) and rupee-dollar exchange rates. Maximum data were collected from 'Hand Book of statistics on the Indian Economy' (RBI) in the year 2010-11 and 2017-18. Apart from we use the official website of Multi Commodity Exchange Limited (MCX), a leading commodity exchange for metal trade in India.

Methodology
We have considered two important variables which are gold price (GP), and rupee dollar exchange rate (D) in India from the year 1970 to 2016. Before analyzing the relationship between gold price and rupee dollar exchange rate, data has been transformed into natural logarithms. In this paper the relationship is explained by using some steps.

- In section I, we test whether the study variables contains unit roots or not. The stationary of each series is tested by using Augmented Dickey Fuller method and Phillips Perron method.
- In section II, we conduct lag selection method. By this method we determine the number of lag appropriate to estimate the model. To estimate the model the number of lagged differences included is determined by the LR, FPE, HQIC, SBIC and AIC method.
- In section III, we detect whether there is a long run relationship exists or not. This is done by using Johansen test of co-integration.
- In section IV, we estimate the model using unrestricted VAR method, and then we use Granger Causality test to detect whether as a whole all the lags of the independent variable affect the dependent variable or not.
- In section V, we explain the stability of the unrestricted VAR model using the method of Eigen value. We also explain impulse response factor and variance decomposition method in this section.
- Finally in section VI we explain residual diagnostic tests. There are different types of residual diagnostic test like the test for autocorrelation, test for normally distributed residuals, and tests for no heteroscedasticity problem.

Model Specification
For the present study the following model has been used.

GP = f (ER)

In log linear form the model can be written as

$LGP = \beta_0 + \beta_1 LER + \epsilon_t$

Where,

LGP = Logarithmic value of Gold Price

LER = Logarithmic value of Rupee-Dollar exchange rate.

β_0 = autonomous part or constant term.

β_1 = slope coefficient.

ϵ_t = Random Error Term.

The slope coefficients β_1 represent how one percent change in rupee-dollar exchange rates affects the percentage change in gold price.

Results and discussion
Section I
- **Trend and growth rate of gold price and rupee-dollar exchange rates:**

The following figures show the trend and growth rate of gold price and rupee dollar exchange rate.

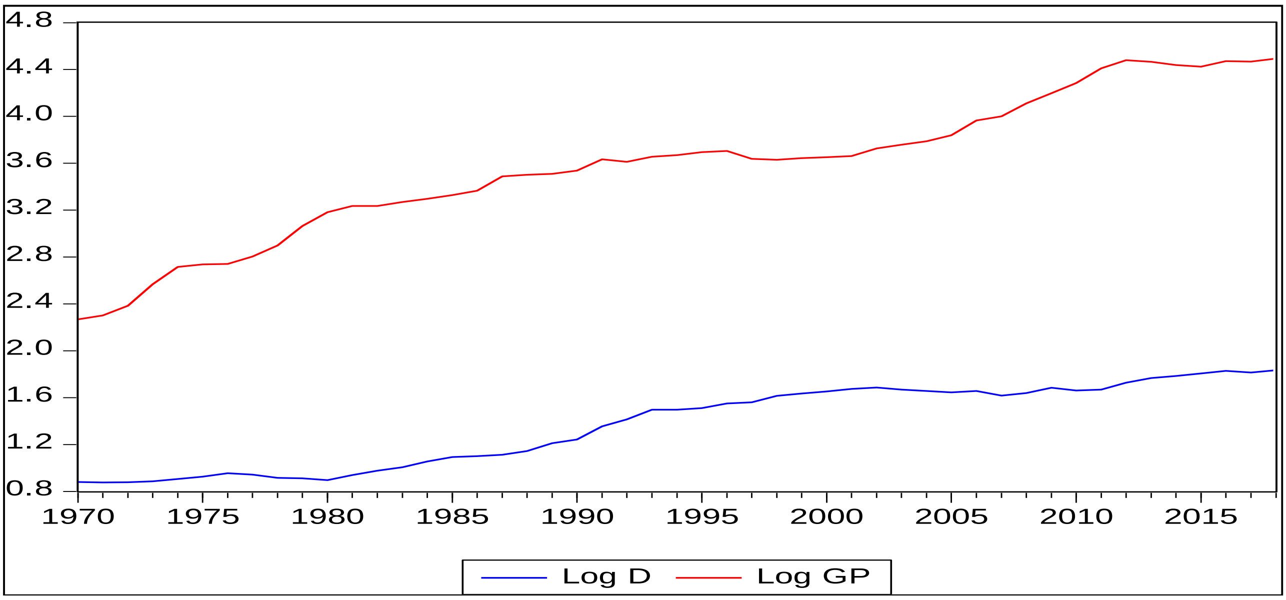


Fig 1: The trend in gold price and rupee dollar exchange rate of India

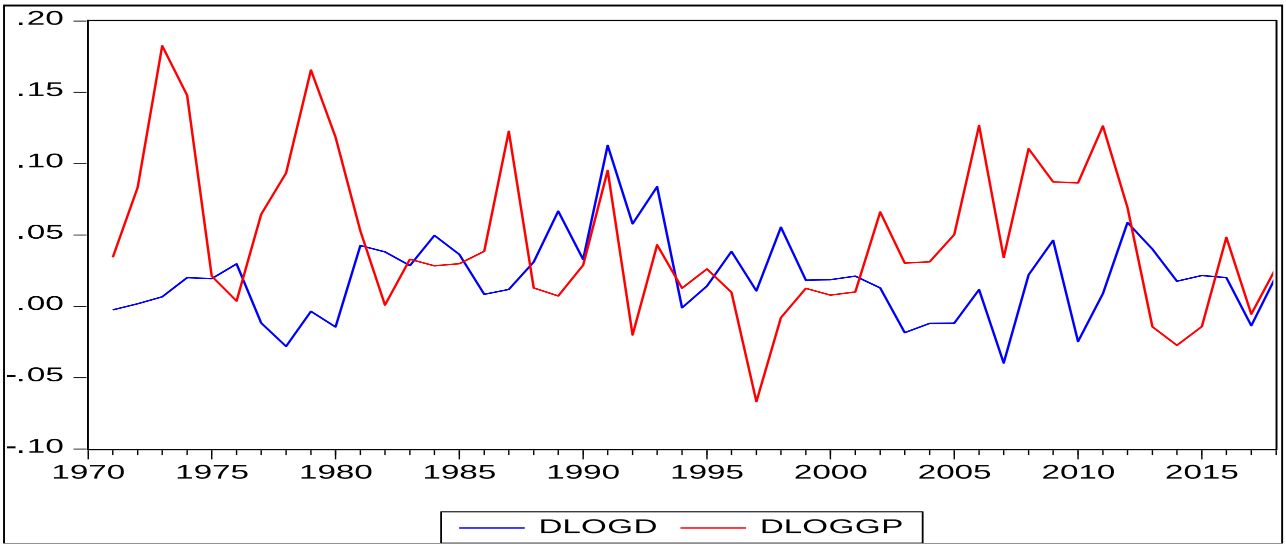


Fig 2: The trends in Growth in gold price and Growth in rupee-dollar exchange rates in India

- **Results of Unit Roots Tests**

To check the stationary of a time series data there are several tests. In this paper to check the stationary of the study variables we conduct Augmented Dickey Fuller test. For double checking we also perform Phillips-Perron test. In both the tests the null hypothesis is

H_0: Presence of unit root or the series is non-stationary.
Against the alternative hypothesis
H_1: Absence of unit root or the series is stationary.
If the value of the test statistic is less than 5% critical value or if the p-value is greater than 5% we accept the null hypothesis that there is a unit root and the series is non-stationary, otherwise the series the stationary.

After applying unit root test the results are as follows:

Augmented Dickey Fuller Test				
	Level		First difference	
Variable	Test Statistics	p-value	Test statistics	p-value
LGP	- 2.125	0.2347	- 4.058	0.0011
LER	- 0.201	0.9384	- 4.640	0.0001

Source: Author's computation using STATA 14 Econometric software.

Phillips Perron Test				
	Level		First difference	
Variable	Test Statistics	p-value	Test statistics	p-value
LGP	Z(rho) = - 1.404 Z(t)= - 1.824	0.3689	Z(rho) = - 24.168 Z(t)= - 4.019	0.0013
LER	Z(rho) = - 0.274 Z(t)= - 0.335	0.9204	Z(rho) = - 31.391 Z(t)= - 4.711	0.0001

Source: Author's computation using STATA 14 Econometric software

From the table, we see that LGP and LER are non-stationary in level but after first difference they become stationary. Therefore, it may conclude that all the variables are integrated of order 1. Since the variables are stationary in first difference, the next step is to judge the long run association among the variables by conducting co-integration test. If there is co-integration among the variables we say that the variables have long run association i.e there is a long run relationship between the variables.

Section –II

- **Results of Lag Selection Method:**

Before conducting co-integration test at first we have to find out how many lag should be used for estimating the model. Determination of lag length is an important factor because larger the Lag Intervals for the variables the more it can reflect the dynamic nature of the model. The results of the lag selection method are as follows:

lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	-8.04889				.005471	0.46739	0.497599	0.549307
1	162.802	341.7	4	0.000	2.3e-06	- 7.29313	- 7.20251	- 7.04738
2	176.621	27.637*	4	0.000	1.5e-06*	- 7.7498*	- 7.59876*	- 7.34022*
3	179.898	6.5538	4	0.161	1.5e-06	- 7.71617	- 7.50471	- 7.14275
4	182.992	6.1893	4	0.185	1.6e-06	- 7.67406	- 7.40218	- 6.93681

Source: Author's computation using STATA 14, Econometric soft ware

LR: sequential modified LR test statistic, HeQ: Hannan-Quinn information criterion, FPE: Final prediction error, AIC: Akaikee information criterion, SC: Schwarz information criterione

From the table we see that according to LR, FPE, AIC, HQIC and SBIC lag should be 2. So, after the comparing of Lag Length Criteria, it is found that the optimal lag order for the model is 2.

Section –III

- **Johansen Co-integration Test:**

To test whether there is a long run association or not among the study variables we conduct Johansen test of co-integration. In Johansen test there are two statistic (i) Trace Statistic and (ii) Maximum Eigen value Statistics. To test the validity of the co-integration let the null hypothesis is

H_0: There is no co-integration.

Against the alternative hypothesis

H_1: There is co-integration.

If the value of the test statistic (Trace Statistic or Maximum Eigen value Statistics) is greater than the critical value at 5% level of significance then we can reject the null hypothesis and conclude that there is co-integration among the study variables. After applying Johansen co-integration test the results are as follows:

Max. Rank	Trace Statistic		Max Statistic	
	Value	5% critical value	Value	5% critical value
0	11.1745*	15.41	8.0628*	14.07
1	3.1118	3.76	3.1118	3.76

Source: Author's computation using STATA 14 Econometric soft ware

From the above table we see that the value of trace statistic is lower than 5% critical value at rank 0. So we can accept the null hypothesis and say that there is no co-integration among the variables.

We get the same result from the maximum Eigen value statistics. The value of the maximum Eigen value statistics at rank 0 is 6.7490 which is lower than the tabulated value. So we can accept the null hypothesis and say that there is no long run association among the study variables.

Section –IV

- **VAR Analysis**

In VAR model there are two issues: long run causality and short run causality. Since the variables are not co-integrated, so there is no long run causality, there is only short run causality running from independent variables to dependent variables. Here all the coefficients are short run coefficient.

The result of the VAR analysis is explained below.

Variable affecting D_ LGP	Coefficient	p-value
First lag of LGP	0.5244224	0.000
Second lag of LGP	-0.2176267	0.085
First lag of LER	-0.9809253	0.000
Second lag of LER	0.3010936	0.229
Constant	0.0474276	0.000
Variable affecting D_ LER		
First lag of LER	0.3108992	0.213
Second lag of LER	0.1057895	0.054
First lag of LGP	-0.11906	0.030
Second lag of LGP	0.1612594	0.523
Constant	0.0105993	0.204

Source: Author's computation using STATA 1, Econometric soft ware

From the above table it is clear that the growth rate of GP significantly depends on the first lag of rupee-dollar exchange rates. This relationship is negative, and the result is significant (*). The growth of GP also depends on the second lag of rupee-dollar exchange rates. This relationship is also positive. But, the result is not significant. So, from the above result we say that there is a negative relationship between growth rate of gold price and rupee-dollar exchange rates. As exchange rate increases gold price will decrease. The inverse relation may exist because of the following reasons:

- When the value of the US dollar decreases the investor will look for alternative sources of investment to store their value, and in this situation gold is an alternative. As the demand for gold increases its price will also increase.
- When the value of the US dollar decreases the value of the currencies of other countries will increase. This will increase the demand for all commodities including gold.
- When inflation occurs in an economy the value of currencies goes down. In this situation individual tried to hold money in the form of gold. As a result demand for gold will increase and this will push gold price higher.
- In some countries like India due to excess demand, gold is imported and hence if the rupee weakens against the dollar, gold price will increases in rupee form.

- **Granger Causality Test**

Granger causality test tells us whether as a whole all the lags of the independent variable affect the dependent variable or not. At first we set two hypotheses. The null hypothesis is

$H_{0:}$ lag independent variable does not cause the dependent variable Against the alternative hypothesis

H_1: lagged independent variable cause dependent variable.

The following table depicts the results of the Granger Causality Wald test:

Null Hypothesis	Chi square value	df	P-value
D_ LER does not cause D_ LGP	20.482	2	0.000
D_ LGP does not cause D_ LER	3.9587	2	0.138

Source: Author's computation using STATA 14 Econometric soft ware

From the result we say that all the lagged value of rupee-dollar exchange rates can cause GP. In this case chi square value is 20.482 and corresponding p value is 0.000. Since the p value is less than 5% level of significance means that we can reject the null hypothesis that D_ LER does not cause D_ LGP. On the other hand all the lagged value of growth of gold price cannot cause rupee dollar exchange rate. In this case chi square value is 3.9587 and corresponding p value is 0.138. Since the p value is more than 5% level of significance means that we can accept the null hypothesis that D_ LGP does not cause D_ LER. Thus the causality test indicates that rupee-dollar exchange rates significantly influence the growth of gold price in Indian economy.

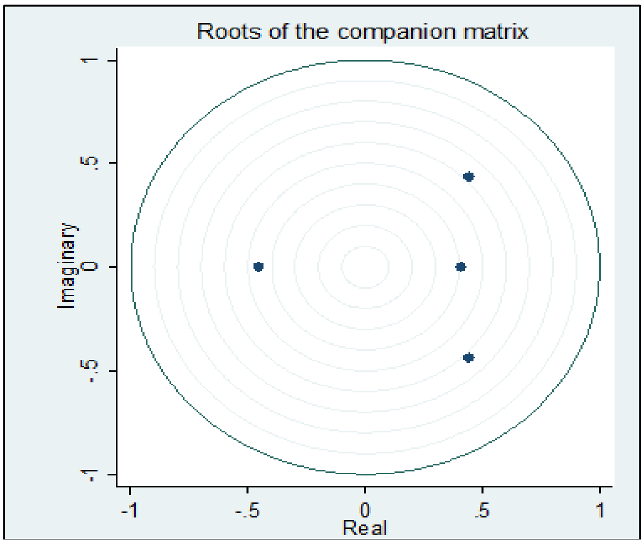
Section –V

- **Stability of the VAR Model**

In this study we conduct the test for stability of the estimated VAR model. We use Eigen value stability condition. It is seen that the modulus of all roots are less than unity and lie within the unit circle as shown in the following table and figure.

Eigenvalue stability condition

Eigenvalue	Modulus
.4409215 + .4365866*i*	.620499
.4409215 - .4365866*i*	.620499
-.4550538	.455054
.4085324	.408532

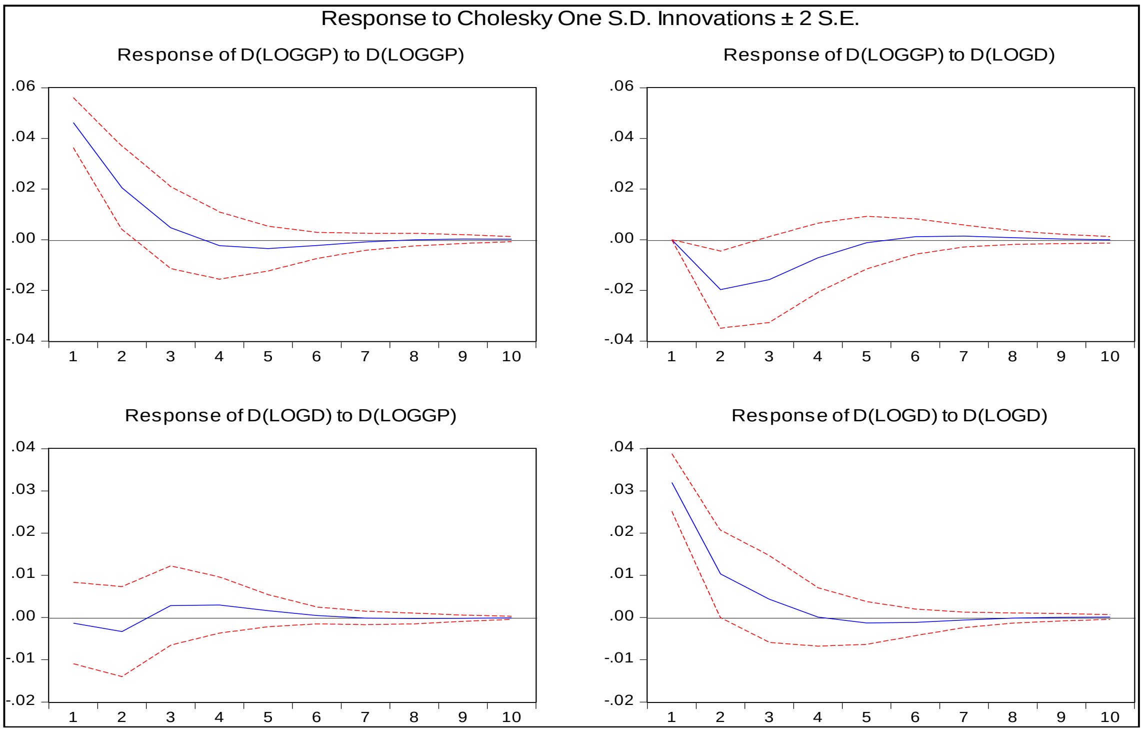


So our estimated VAR model is stable.

- **Impulse Response Function:**

Impulse response function is a shock to a VAR model. When we estimating a VAR model there may be a large number of estimated parameters. For this we cannot interpret the parameters properly. To overcome this problem we use impulse response function. The impulse response function trace out the responses of the dependent variable when there is a shock. More specifically, by impulses we mean a factor which will give a shock. On the other hand by responses means how the other variables will be reacting for this shock.

The graphs of the impulse responses are shown below.



The solid horizontal line is a zero line. When we go up to this line means there is positive shock, and when we go below the line means there is a negative shock. To explain the concept we chose 10 years into the future. First consider the response of D_ log GP to D_ log GP, means that if there is a positive shock of one s.d to log GP, how it will affect its own value. Here the blue line is the reaction pattern. So we can say that its own value gradually decreases and then equal to zero. In other words after 10 years reaction becomes zero.
Now consider the response of D(logGP) to D(logD), means that if there is a positive shock of one s.d to log D, how it will affect D(logGP). We can say that its value initially decreases and then increases but after 6 years the value comes closer to zero. In other words after 6 years reaction becomes zero.
We can also explain the response of D_ log D to D_ logGP, means that if there is a positive shock of one s.d to log GP, how it will affect D_ log D. We can say that its own value initially decreases and then increases but after 10 years the reaction becomes zero.
Consider the response of D_ log D to D_ log D means that if there is a positive shock of one s.d to log D, how it will affect D_ log D. We can say that its value gradually decreases and after 10 years the value comes closer to zero. In other words after 10 years reaction becomes zero.

- **Variance Decomposition:**

In a VAR model, there is an alternative method to determine the effects of shocks to the dependent variables. This is known as variance decomposition method. The technique determines how much of the forecast error variance for any variable is explained by shocks in each explanatory variable over a series of time horizon. In this method it is necessary to choose an ordering of the variables. There are different methods for this purpose but we use Cholesky decomposition method. The result of the variance decomposition is shown in the following table:

Variance Decomposition of D(LGP):			
Period	S.E.	D(LGP)	D(LER)
1	0.041975	100.0000	0.000000
2	0.053650	74.40470	25.59530
3	0.055855	69.79250	30.20750
4	0.056671	68.81568	31.18432
5	0.057022	69.17902	30.82098
6	0.057219	69.19557	30.80443
7	0.057275	69.08528	30.91472
8	0.057285	69.07246	30.92754
9	0.057293	69.08070	30.91930
10	0.057297	69.07991	30.92009
Variance Decomposition of D(LER):			
1	0.027790	0.857973	99.14203
2	0.029392	2.806167	97.19383
3	0.030881	3.765914	96.23409
4	0.031046	4.690228	95.30977
5	0.031187	5.545377	94.45462
6	0.031231	5.645769	94.35423
7	0.031237	5.644972	94.35503
8	0.031240	5.659750	94.34025
9	0.031242	5.670051	94.32995
10	0.031243	5.672239	94.32776

From the table we see that in the short run, for example in period 2, a shock to D_(LGP) can cause 74.40% variation of the fluctuation in the D_(LGP). But in the long run, for example in period 10, the contribution of D_ (LGP) has gone down and reaches to 69.07%.
Now consider the case of D_ (LER). In period 2 a shock to D_ (LER) can cause 25.59% variation of the fluctuation in the D_(LGP). But in period 10, the contribution of D_ (LER) has increased and reaches to 30.92%. In other words contribution of D_ LER to D_ LGP increases.

Section –VI

- **Residual Diagnostics Tests:**

To verify that our empirical work is acceptable and that our estimate is well treated, we use a set of tests known as residual diagnostic tests. Residual diagnostic tests indicate that the overall specification adopted is satisfactory.

- **Test for Autocorrelation:**

To test that there is no autocorrelation problem in the model we use LM test. The LM statistic follows chi-square distribution with nine degrees of freedom.
The null hypothesis is
H_0: No autocorrelation in the model Against the alternative hypothesis
H_1: There is a problem of autocorrelation.

The result of LM test is shown in the following table

Table 1: Results of Lagrange-Multiplier (LM) Test

Lag	Chi square	Df	p-value
1	3.2366	4	0.51904
2	5.0520	4	0.28200

From the table we see that at lag 1 the value of chi-square at 4 d.f is 3.2366 and corresponding p-value is 0.51904. Since the p-value is more than 5% so we can accept the null hypothesis that there is no autocorrelation problem. Again at lag 2 the value of chi-square at 4 df is 5.0520 and corresponding p-value is 0.28200. Since the p-value is more than 5% so we can accept the null hypothesis that there is no autocorrelation problem.

- **Test for Heteroscedasticity:**

To test that the variance of the residual is constant in the model we use Breusch-Pagan-Godfrey test. Here the null hypothesis is
H_0 : There is no heteroscedasticity problem.
Against the alternative hypothesis
H_1 : There is a problem of heteroscedasticity
The result of Breusch-Pagan Godfrey test is shown in the following table

Chi square	Df	p-value
17.60577	24	0.8217

From the table we see that the value of chi-square at 24 df is 17.60577 and corresponding p-value is 0.8217. Since the p-value is more than 5%, we can accept the null hypothesis that variance of the residuals are constant or there is no heteroscedasticity problem.

- **Test for Normality of the Residuals:**

To test that the residuals are normally distributed in the VAR model we can use Jarque - Bera test. The Jarque - Bera statistic follows chi-square distribution.
Here the null hypothesis is

H_0: residuals are normally distributed.
Against the alternative hypothesis
H_1: residuals are not normally distributed.
The result of Jarque Bera test is shown in the following table

Table 2: Results of Jarque Bera Test

Equation	Chi square	Df	p-value
D_ LGP	0.308	2	0.85746
D_ LER	5.501	2	0.06390
ALL	5.808	4	0.21392

From the above result we say that the residuals are normally distributed. In this case the p-value is greater than 5%, so there is no reason to reject the null hypothesis and infer that the residuals of D_ log GP are normally distributed.

Conclusion

In this paper, we have examined the relationship between gold price and rupee dollar exchange rate in India using time series data from 1970 to 2016. In other words we want to check how rate of change of rupee dollar exchange rate affect the growth rate of gold price in India. This study uses the ADF unit root test, Johansen test for co-integration, VAR analysis and Granger causality test. The stable VAR model shows that in between the periods 1970 and 2016 the growth rate of gold price in India depended significantly and negatively on the rupee dollar exchange rate. VAR analysis is done on the growth levels of the two variables. It is seen that the growth of gold price significantly depends only on the first lag of rupee-dollar exchange rates. This relationship is negative, and the result is also significant. The growth of gold price also depends on the second lag of rupee-dollar exchange rates. This relationship is also negative. But, the result is not significant. We say that there is a negative relationship between growth of gold price and rupee-dollar exchange rates. As exchange rate increases gold price will decrease. The causality test indicates that rupee dollar exchange rate influence the gold price of the Indian economy. Since the variables are not co-integrated, so there is no long run causality, there is only short run causality running from independent variables to dependent variables.

References

1. Girish KN, Choudhari N, Purohit H. The relationship between gold prices and exchange value of US Dollar in India, Emerging market Journal 2015;5(1):17-25.
2. Omag A. An observation of the relationship between gold prices and selected financial variables in Turkey, The Journal of Accounting and Finance, 2012, 195-206.
3. Patel SA. Gold as a strategic prophecy against inflation and exchange rate, Working Paper, Business Perspective and Research 2013,
4. Subhashini S, Poornima S. An empirical investigation of the causal relationship between Gold price, Exchange rate and Crude oil price, International Journal of Management Research and Review 2014;4(10):981-987.
5. Kiohos A, Sariannidis N. Determinants of the asymmetric gold market. Investment Management and Financial Innovations 2010;7(4):26-33.
6. Greene WH. Econometric Analysis, Prentice Hall.
7. Maddala GS. Introduction to Econometrics, John Wiley & Sons Ltd.
8. Damodar N. Gujarati: Basic Econometrics, Mc Graw Hill Education Private Limited.
9. Dickey DA, Fuller WA. Distribution of the Estimators for Autoregressive Time Series with a Unit Root. Journal of the American Statistical Association 1979; 74:427-431.
10. Johansen S. Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control 1988;12:231-254.
11. Johnston J, Dinardo J. Econometric Methods, McGraw Hill.
12. Koutsoyiannis A. Theory of Econometrics, ELBS with Macmillan.
13. Das NG, Statistical Method, M. Das & Co